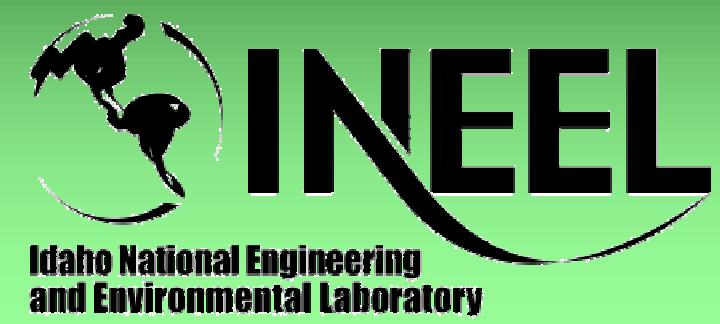


Multi-Media Environmental Sampling for Mercury Near a DOE Emission Source in Southeastern Idaho



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INTRODUCTION

Since the start of the Industrial Revolution, human activities such as mining, fuel combustion, and industry have resulted in increased pollutant loads to the atmosphere and terrestrial ecosystems. One of these pollutants, mercury (Hg), is of primary concern because of its persistence, bioaccumulative nature, and toxicity. Understanding Hg inventories and transport in the environment is complicated by the fact that it exists or can change into different chemical species, which are transported differently and cycle between air, soil, water, and biota.

For the past 38 years, Hg has been emitted from thermal waste treatment operations at the Idaho Nuclear Technology and Engineering Center (INTEC), located on the Idaho National Engineering and Environmental Laboratory (INEEL) in southeastern Idaho. During intermittent operations of one process (calciner), Hg emissions were measured at 9-11 g/hr of mostly oxidized Hg(II), suggesting that over 1500 kg of Hg could have been released to the atmosphere. In 1999, we began a multi-media environmental sampling program to assess potential impacts from this source and to better understand Hg cycling across the Eastern Snake River Plain (ESRP) region.

OBJECTIVES

- Develop sampling and analysis methods to measure Hg in various environmental media on the INEEL and across the ESRP.
- Perform comprehensive sampling to determine if INEEL operations have increased local/regional Hg levels.
- Advance our scientific understanding of the relative impacts of Hg sources and environmental cycling in the region to contribute to national emission control strategies.

Hg measured in:

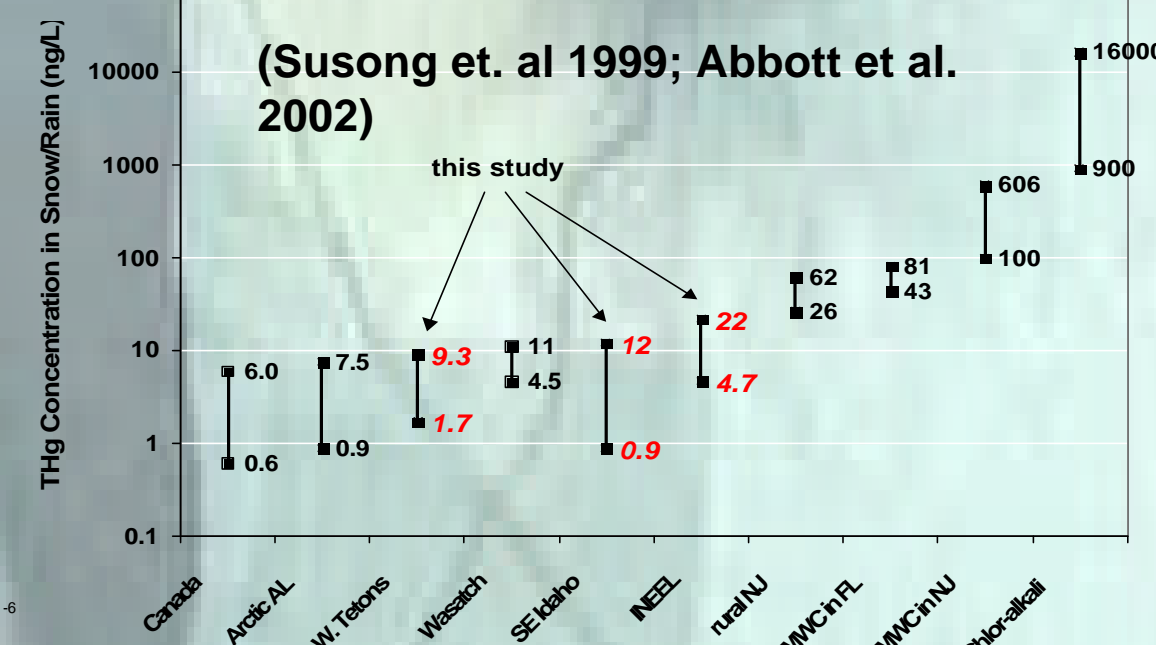
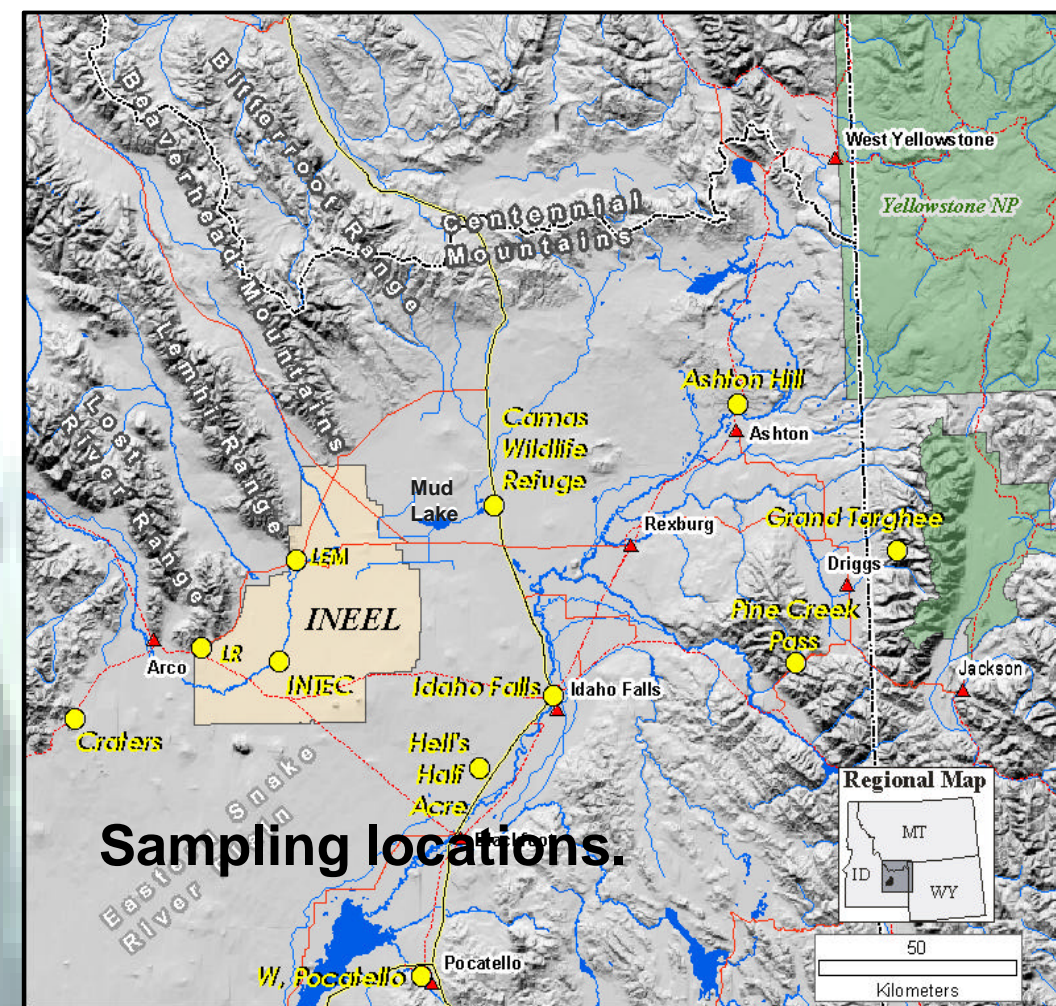
Snow: to assess air-to-ground deposition rates and calibrate existing air models (ISCST3).

Surface soil: to assess residual buildup of fallout around INTEC.

Lake sediment: to reconstruct historical deposition trends in the region.

Air: to assess current Hg sources and soil-to-air re-emission flux.

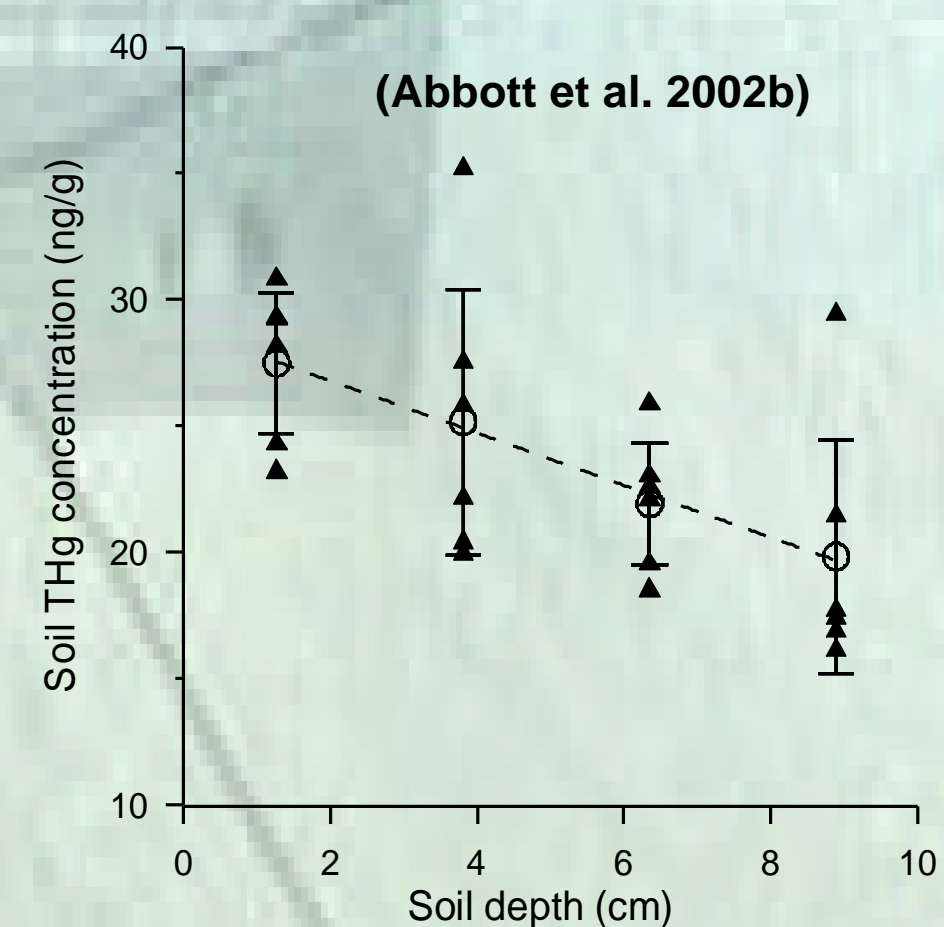
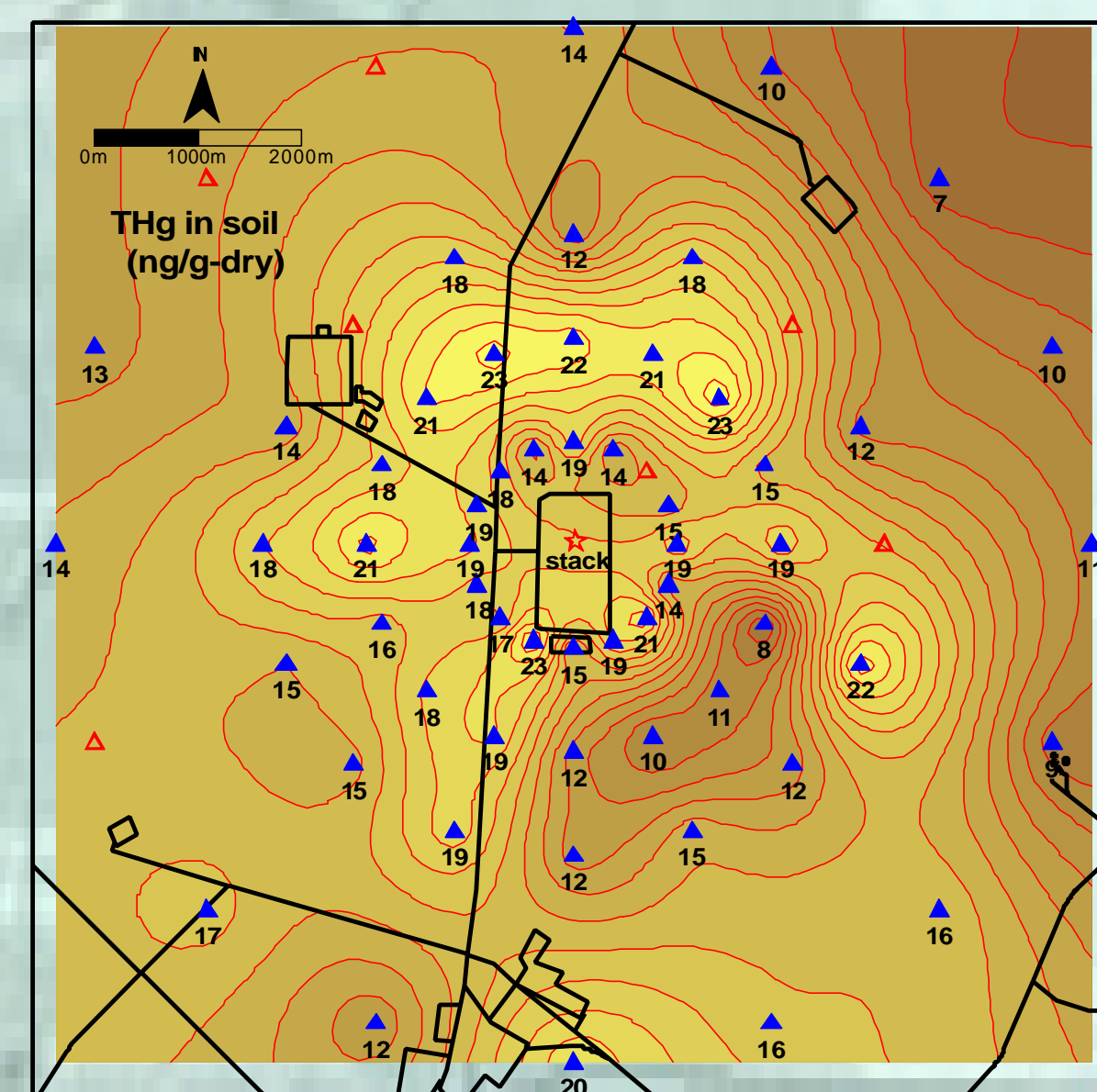
SNOW



300 samples taken over 3 winters (1999-2001)
Ultra-clean sampling methods - acid-cleaned teflon bottles, double containment.

Analysis at USGS Mercury Research Lab (MRL), Madison, WI - Total Hg - EPA Method 1631; Methyl-Hg - EPA Method 1630.

SOIL



103 samples within 5-km of INTEC in summer of 2000.

30 mL composite samples (4 locations), teflon vials.

Acid digestion, analysis by EPA methods 1631 and 1630.

LAKE SEDIMENT



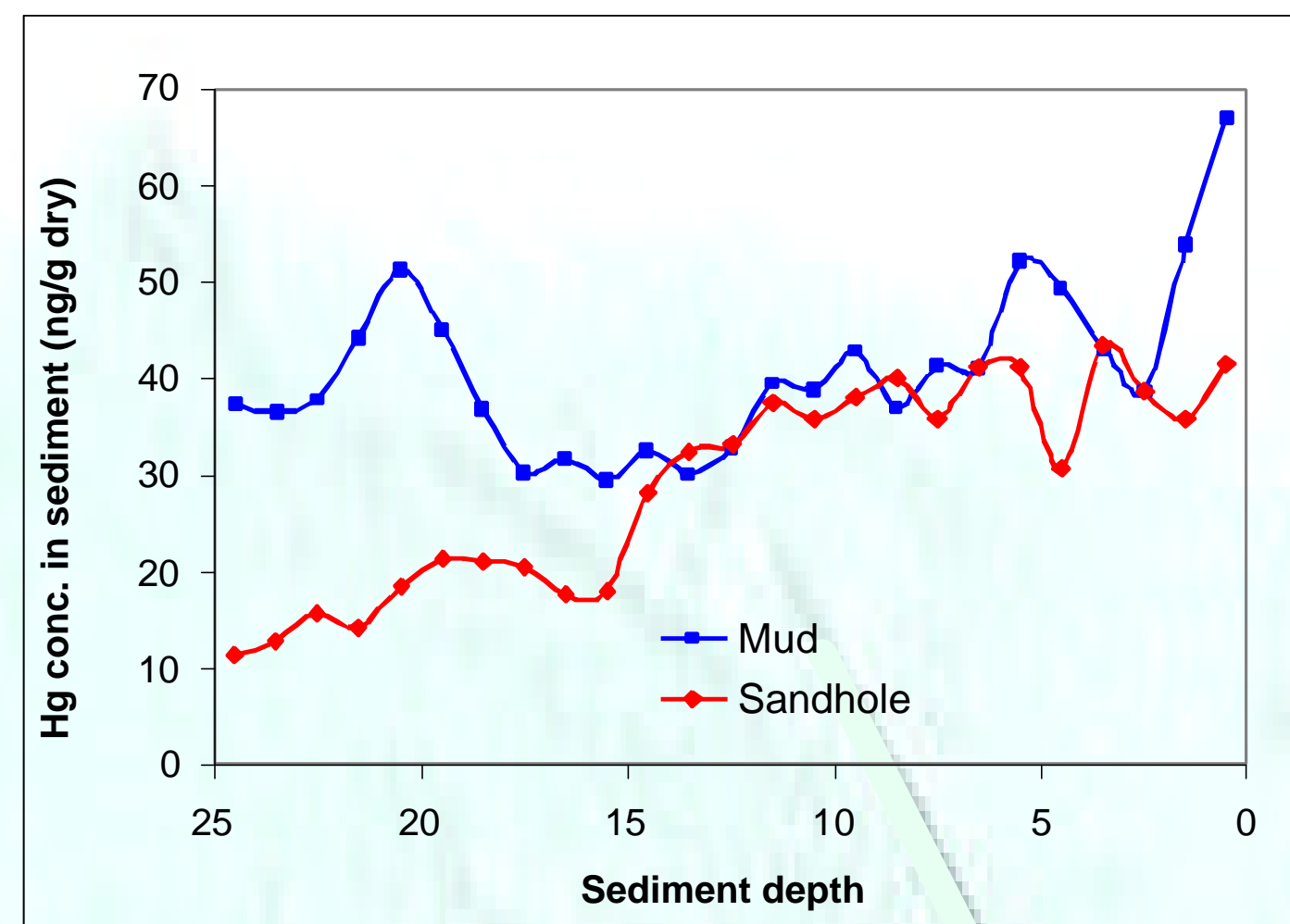
Two lakes - Mud Lake - 55 km downwind (NE) of INTEC and Sandhole Lk. at Camas NWR, 10-km E. of Mud Lake.

Mud: Wildco® hand corer+10-ft. extension, 5-cm dia x 30-cm deep cores, sliced into 1-cm layers, 4 cores composited.

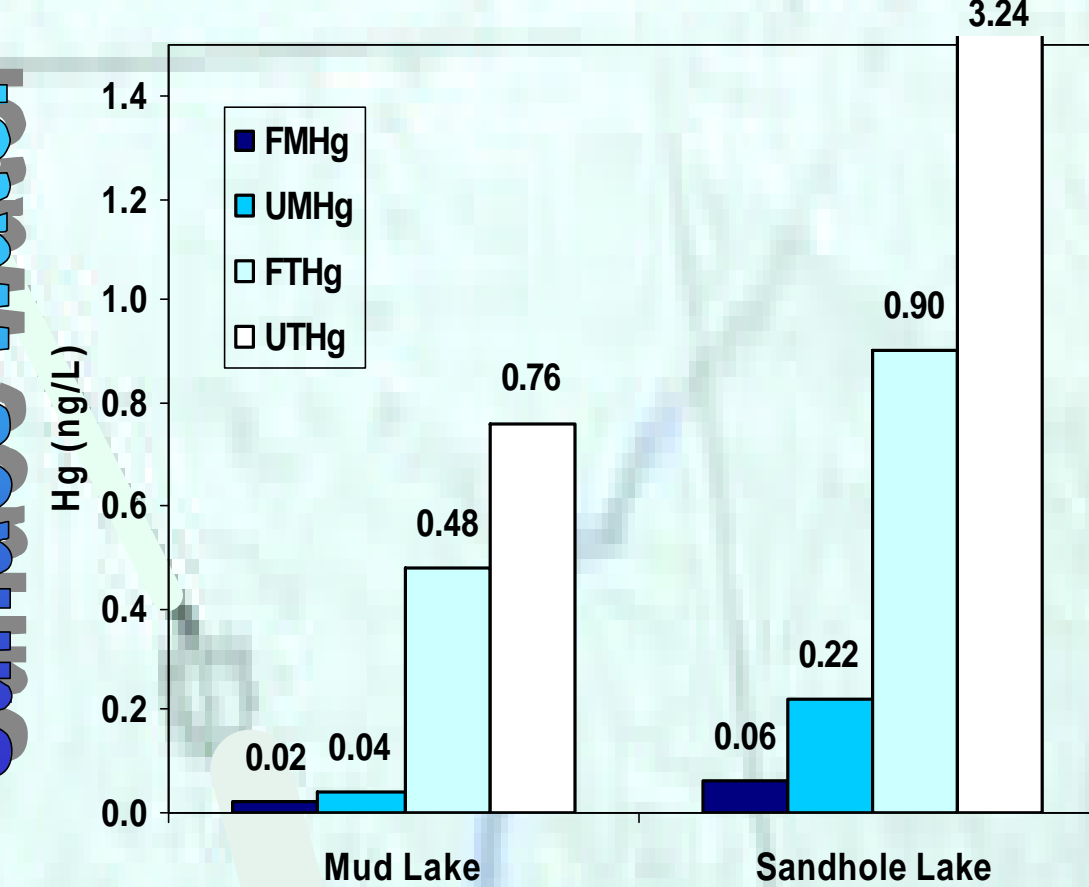
Sandhole: 8-cm dia tube pushed into sediment.

Plunger device for extruding/slicing core.

Analyzed for porosity, LOI, particle size, Cs137, Pb210, and THg (USGS MRL).



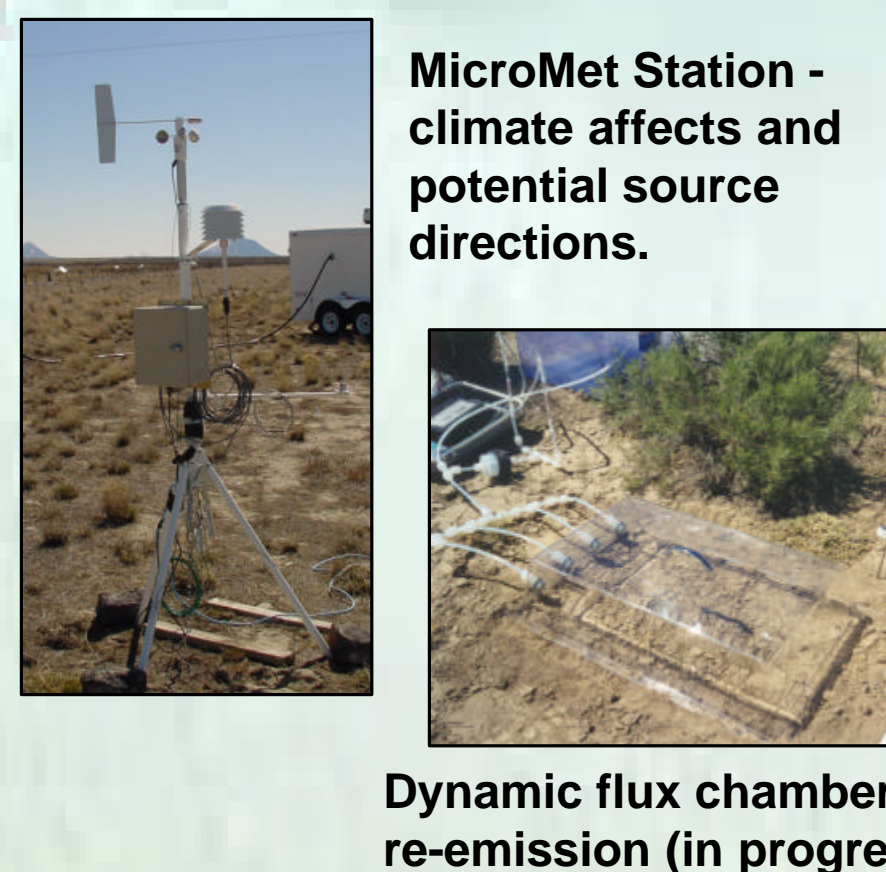
Surface Water



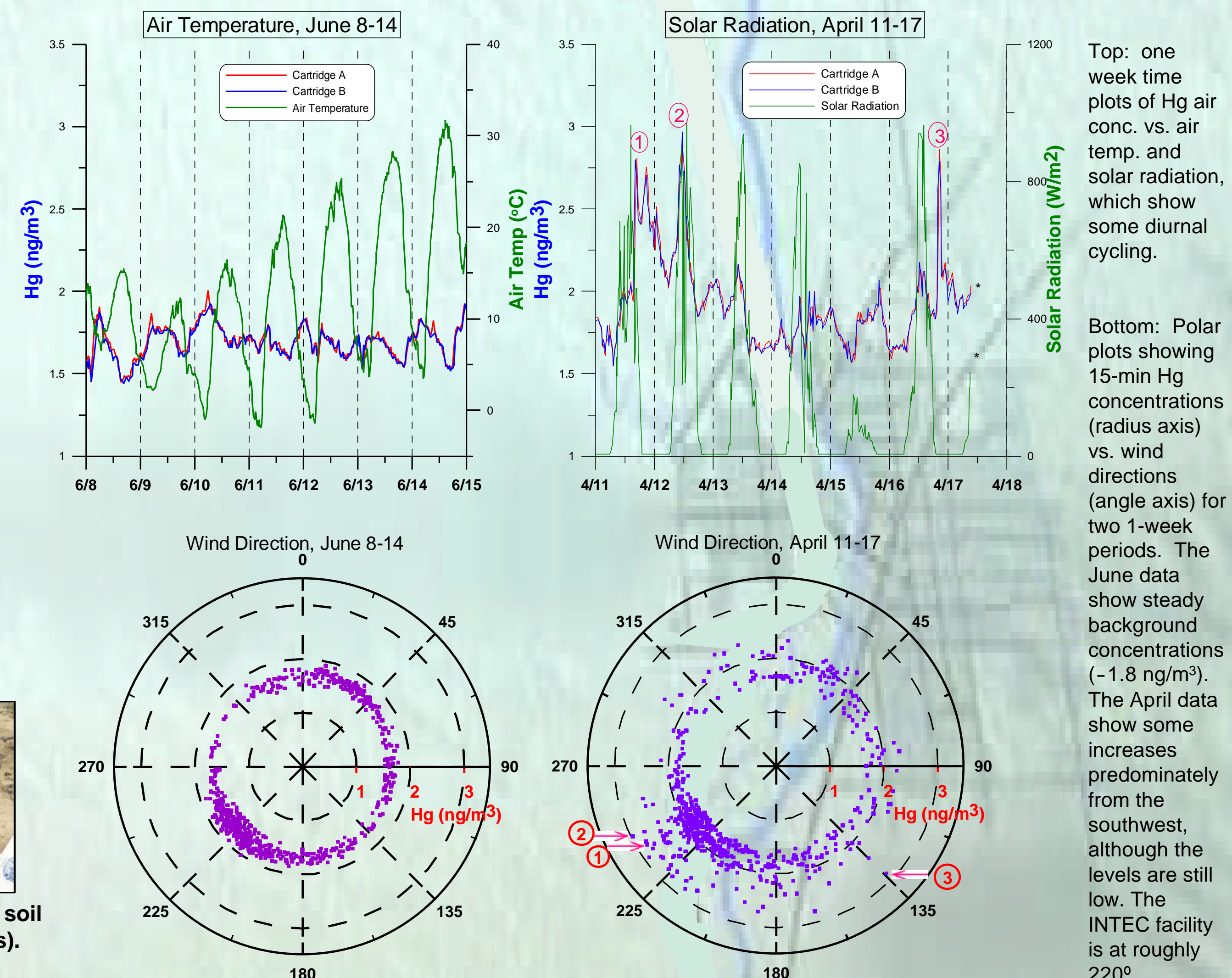
Left: Filtered (F), unfiltered (U), methyl (M), and total (T) Hg concentrations at Mud Lake are lower likely due to the ground water recharge source for this lake, vs. watershed recharge at Sandhole.

AIR

Tekran® Model 2537A analyzer in a self-contained field trailer, continuous 15-minute samples.



Dynamic flux chamber - soil re-emission (in progress).



Top: one week time plots of Hg air conc. vs. air temp. and solar radiation, which show some diurnal cycling.

Bottom: Polar plots showing 15-min Hg concentrations (radius axis) vs. wind directions (angle axis) for two 1-week periods. The June data show steady background concentrations (~1.8 ng/m³). The April data show some increases predominately from the southwest, although the levels are still low. The INTEC facility is at roughly 220°.

CONCLUSIONS

Snow - Concentrations downwind from INTEC (4.7 - 22 ng/m³) were twice those at ESRP background sites (0.9 - 12 ng/m³), which are in the range observed for other remote areas of the U.S. and much lower than those in the eastern U.S. The ISC3 model predicted within a factor of two of the observed deposition.

Soil - Surface (0-2 cm) concentrations ranged from 15 - 20 ng/g and increased slightly at distances closer than 5 km from the main facility stack, indicating some input from sources at INTEC. However, all concentrations measured were very low compared to background levels in similar soils around the US (50 - 70 ng/g).

Lake Sediment - Concentrations in the upper (recent) layers were factors of 2-4 higher than in the bottom of the cores. Age-dating indicated 100 years of record with recent Hg accumulation rates (mg/m²/year) ranging from 1.4 to 5.4 times higher than pre-industrial rates at the bottom of the cores. This increase is similar to the 3 to 5 fold increases in global background observed in other sediment studies.

Surface Water - Concentrations (0.8 - 3.2 ng/L) were within the range of those observed at other non-impacted locations in the U.S.

Air - Concentrations 4 km downwind from INTEC (1.2 - 3.0 ng/m³) are in the range of global background (around 2 ng/m³) and varied diurnally with air temperature and solar radiation. No large increases observed during the period 28 March-18 June, 2002.

References

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